Space Weather Technical Forecast

Issued on Saturday, 26 November 2022 at 12:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Minor Geomagnetic Storm (G1) intervals through the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low in the past 24 hours, with occasional upper level B-class flares. There are currently four numbered Earth-facing sunspots small, simple and apparently stable. Three of the regions are transiting toward the western limb, with the other region located in the northeast quadrant.

No new Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1 has been mainly in the range, mainly between 460-560km/s under coronal hole influence, with a slight downward trend since midnight UTC. The phi angle was mostly positive (away from the Sun). The solar wind density was steady, near 10ppcc. The corresponding IMF was at mainly Weak levels 5-9nT. The north-south component fluctuated between +8/-7nT. Geomagnetic activity was mostly Unsettled, but with an Active (Kp 4) spell between 25/2100-26/0300 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at Normal Background levels. Electron fluence levels remained well below Active (1e8 integrated pfu) levels. Observed fluence at 26/0001UTC was 1.16e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low or Very Low, with a chance of isolated C-class flares and a very slight chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: Several recent CMEs have occurred on, or close to the Earth-Sun line. There is greater than average uncertainty regarding the timings and impacts of these features however, given intermittent solar imagery and faint coronagraph signatures to fit analysis.

The ongoing HSS from a coronal hole, coupled with further HSS expected in the coming days means that Elevated solar winds are expected to continue through 26-28 Nov (Day 1-3), perhaps slowing to Slightly Elevated levels on Day 4 (29 Nov), though with low confidence.

Geomagnetic activity is expected to be mainly Unsettled to Active on Day 1, but with a chance of G1/Minor storm intervals. From Day 2 onwards mainly Unsettled activity is expected, but with low confidence given the presence of a number of HSS and uncertain CME timings and impacts. As such, there will be an ongoing slight chance of G1/Minor Storm intervals throughout the

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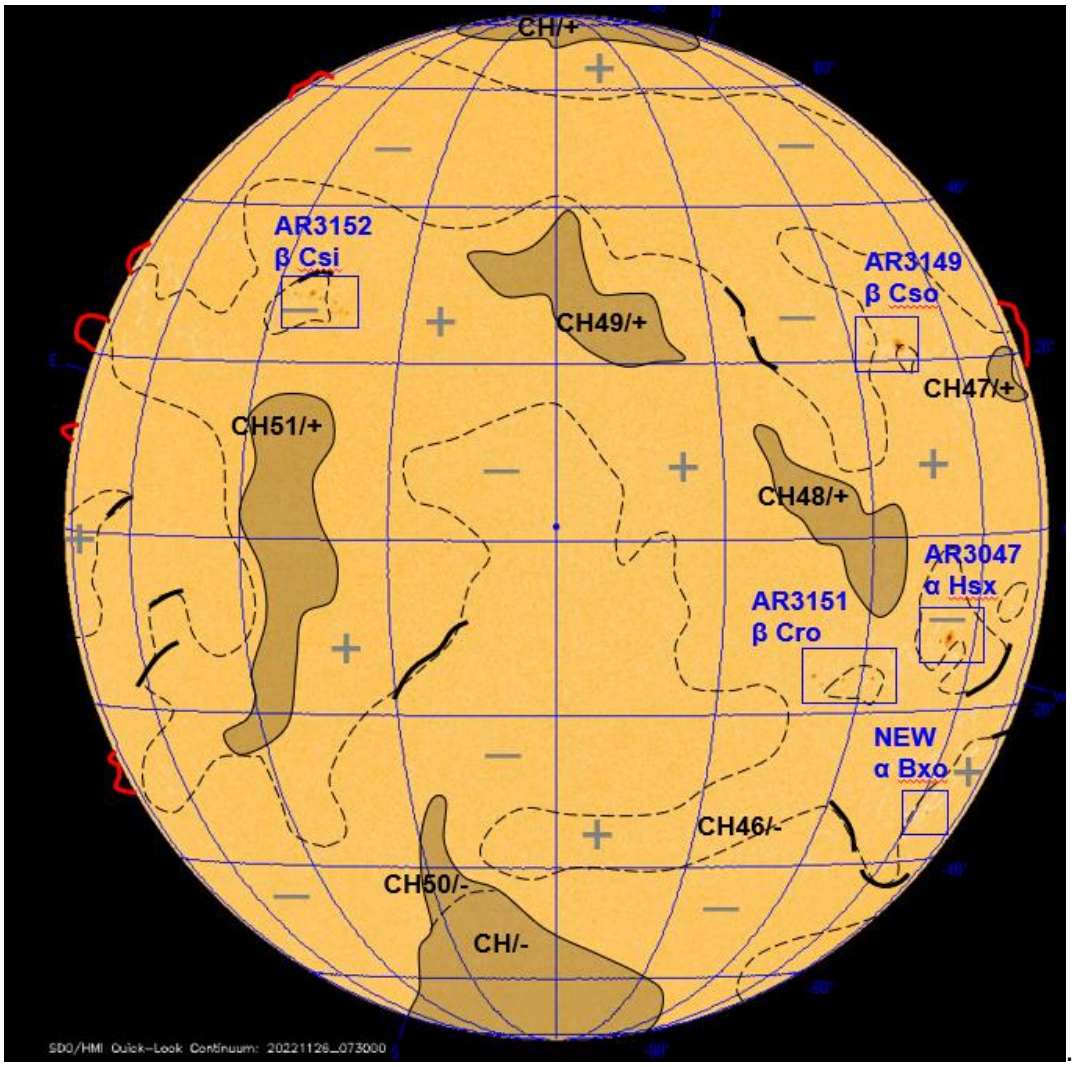
period.
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES16 is expected to remain at Background levels throughout.
The high energy Electron flux (greater than 2MeV) at GEO is forecast to gradually react to the incumbent fast wind in the period, although the magnitude to which this adjusts is low confidence. The associated 24-hour integrated fluence is expected to remain below Active (1e8 integrated pfu) at first, however confidence in this persisting falls with time, especially from later in the UTC weekend - with a rising trend expected, then perhaps decreasing again on 28-29 Nov.

Figure 1. Solar Analysis Valid 26/0730 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Several recent CMEs have occurred on, or close to the Earth-Sun line. There is greater than average uncertainty regarding the timings and impacts of these features however, given intermittent solar imagery and faint coronagraph signatures to fit analysis.

The CME from the C7 flare at 22/0727UTC and a CME from the C4 flare of AR3151 at 22/1900UTC are both likely to pass beneath Earth's orbit, but may give a glancing blow with minor peripheral impacts on 26 Nov (Day 1).

On 24 Nov a two-stage filament eruption was observed from a region near the centre disc in the southern hemisphere. At around 24/1430 UTC an E-W portion of the filament lifted off the sun, followed by a NNE-SSW-lying portion between 24/1800-2100 UTC. These both resulted in a faint CME signature on coronagraph imagery, however, analysis of the CME(s) was very difficult, with significant imagery gaps compounding the faint CME trace. An Earth-directed component is expected, however, confidence in timings and effects are low and the CME could arrive anywhere between the 27-29 Nov.

Earth is currently assessed to be in the HSS of CH47/+ and may also encounter the HSS from CH48/+ on Day 1 (26 Nov). Since these coronal holes carry the same polarity and appear tenuously connected in some EUV imagery, any transition may be indistinct, and may indeed form a more continuous fast wind with speeds of 500-550km/s. CH49/+ in the northern hemisphere, also a recurrent feature, should be expected at Earth from 29 Nov (Day 4) with speeds more typically around 450-500km/s.

Geomagnetic activity is expected to be mainly Unsettled to Active on Day 1, but with a chance of G1/Minor storm intervals. From Day 2 onwards mainly Unsettled activity is expected, but with low confidence given the presence of a number of HSS and uncertain CME timings and impacts. As such, there will be an ongoing slight chance of G1/Minor Storm intervals throughout the period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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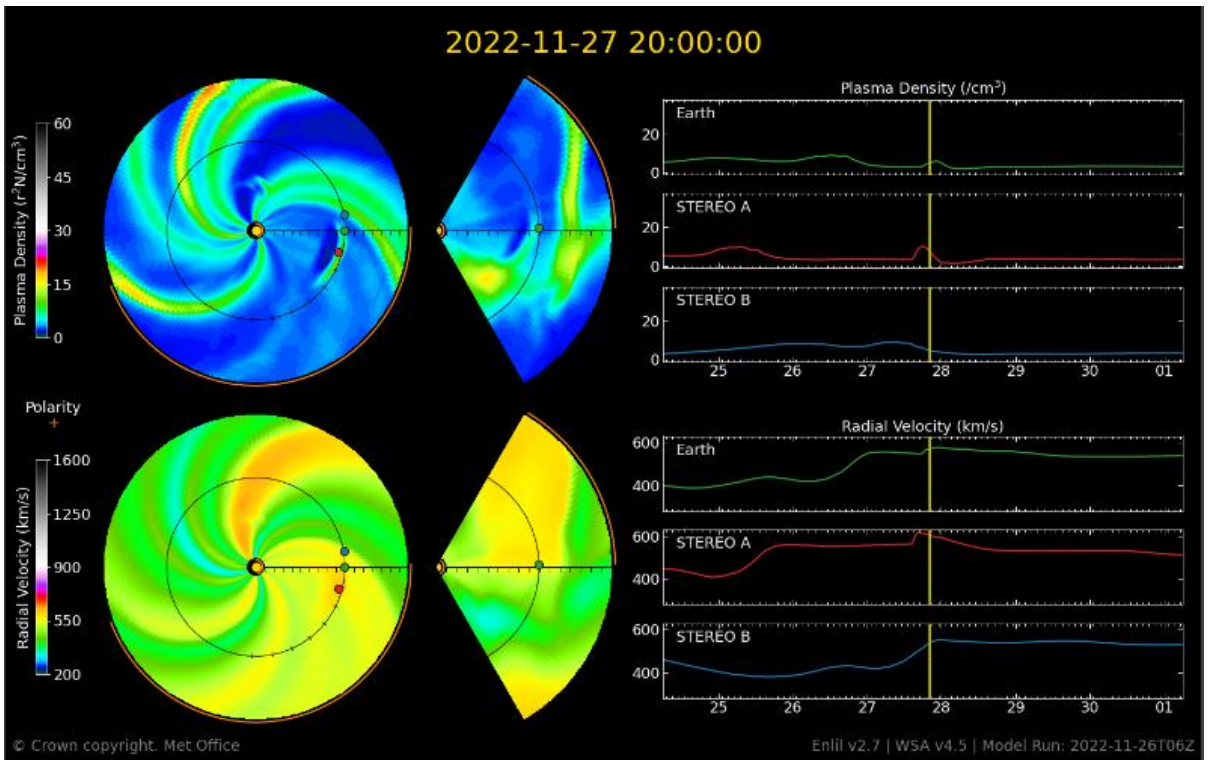
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
23/0310	Partial	C4 AR3151	SE quadrant	500 km/s	Late UTC day 26 Nov	Glancing blow, low confidence
23/1925	Partial	C7 AR3151	SE quadrant	405 km/s	Late UTC day 26 Nov	Glancing blow, low confidence
25/1904	Partial	Filament	S Hemisphere (centre disc)	630 km/s	Anytime between 27/1200-29/0001	Low confidence in timings

Figure 2: MOSWOC Enlil with ensembles, indicating two possible CMEs on 26 Nov and another between 27-29 Nov.



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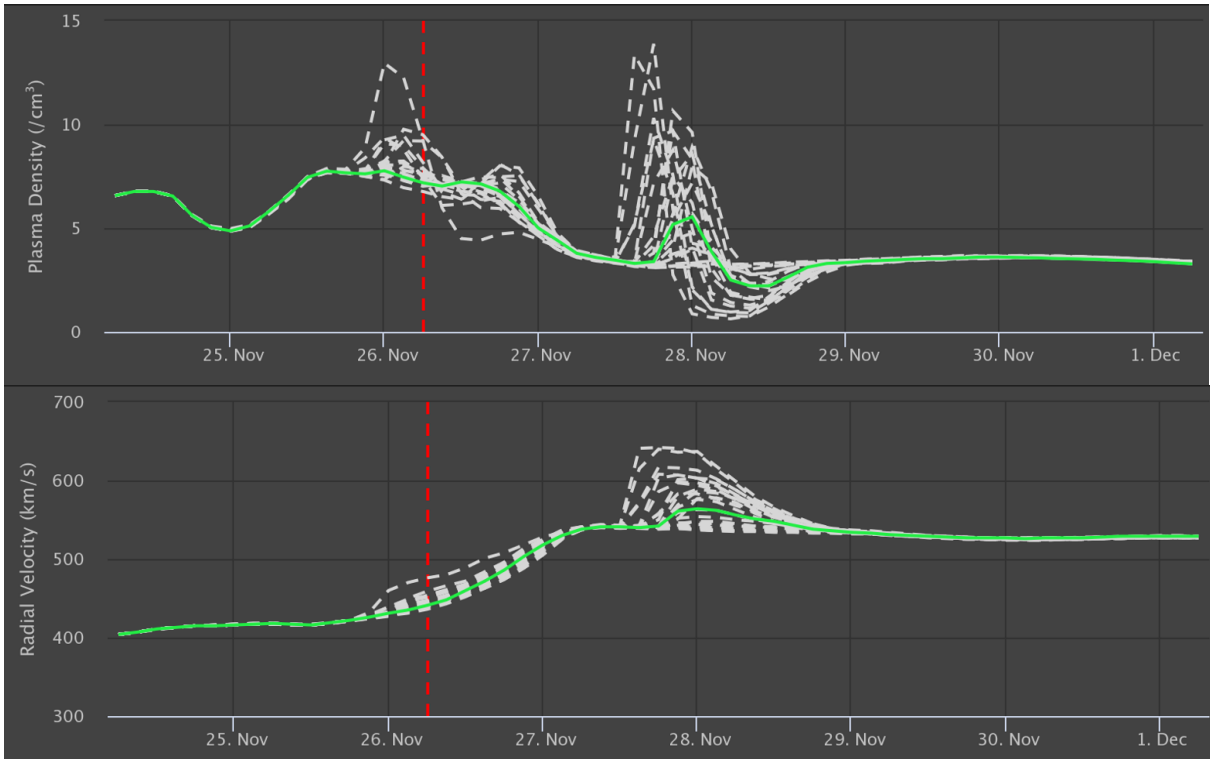
Met Office Space Weather Technical Forecast



Radio Blackouts - X-Ray Flares:

Solar activity is forecast to remain Low or Very Low over the four-day period with all of the current four numbered Earth-facing sunspots small, simple and apparently stable. Three of the regions are transiting toward the western limb, with the other region located in the northeast quadrant.

Meanwhile, on the eastern horizon, the Carrington locations for several far sided regions should arrive at the eastern limb from 28 Nov (Day 3). This results in an overall level trend through the four days as none of the upcoming sunspot groups has shown inferred significant flare or CME activity from coronagraph imagery.

Overall there is a chance of further isolated C-class flares, with a very slight chance of isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

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The high energy proton flux (greater than 10MeV) at GEO, as observed by GOES16 is currently at background levels and is expected to remain at this level throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) observed by GOES16 has been at normal background levels in recent days. The effects of the incumbent fast wind on electron populations at GEO should start to be seen into the coming UTC weekend, with the current flux perhaps reaching diurnally High levels in the succession of CH47/+ and then CH48/+, although this depends on intervening CME activity and the magnitude of these HSS.

The quieter conditions that should greet the forthcoming new UTC working week should allow the Van Allen belts to equilibrate, and offers the greatest likelihood of exceeding Active 24-hour integrated fluence. This suggestion is based on recurrence from the previous rotation, where Active fluence was observed, though confidence is rather low given additional complications owing to one or more CMEs expected during the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	30	60	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: Latest MOSWOC REFM output

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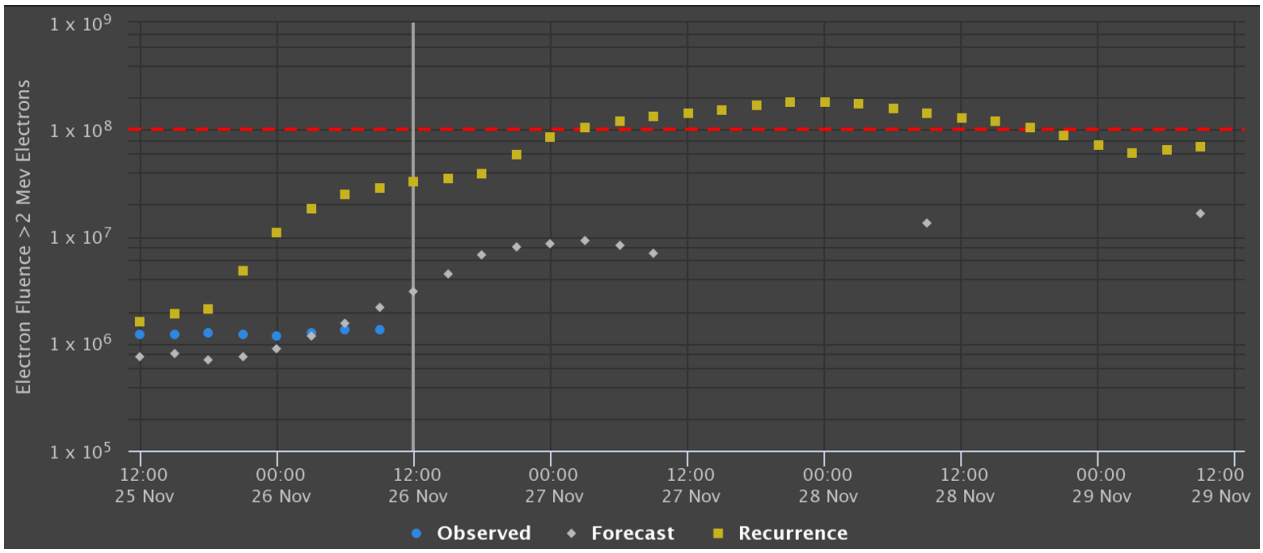

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